Technology Opportunity

Solar Dynamic Power System

The National Aeronautics and Space Administration seeks to transfer solar dynamic (SD) power systems technology as an alternative to photovoltaic (PV) power systems. For certain applications, this technology will offer significant mass and cost savings over PV systems.

Potential Commercial Uses

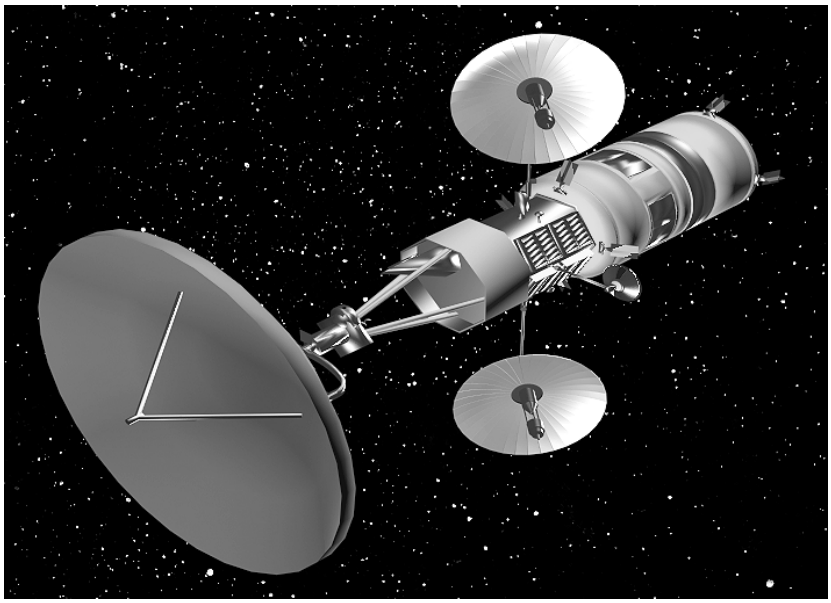
- Large communication satellites
- Satellite constellations in low or medium Earth orbits
- Satellites in high-radiation orbits

Benefits

- Higher sun-to-user conversion efficiency than PV systems
  - Less aerodynamic drag and less propellant required to maintain orbit
  - Smaller overall system configuration
- Uses thermal energy storage instead of batteries
  - Thermal storage has higher kW-hr/lbm
- Recurring cost is less than PV

Technical Description

An SD power system is a system that converts solar thermal energy to mechanical energy, which is then converted into electrical energy. The thermal-to-mechanical energy conversion process is usually carried out by using a Brayton, Rankine, or Stirling thermodynamic cycle. In all cycles, the fluid undergoes a process of heat addition, production of mechanical work, and heat rejection. The heat addition needs to occur at a relatively high temperature to obtain good cycle efficiency. This is achieved with a solar collector that concentrates solar energy. The collector focuses the concentrated energy into a solar receiver target where the heat energy is transferred to the working fluid. The receiver may also include thermal energy storage that will allow the SD system to continue to operate with more-or-less constant output power while the collector is in eclipse. All SD systems must include a means for heat rejection. The rejected thermal power would likely equal three times or more the electrical output power, depending on the cycle efficiency. The heat



Satellite with solar dynamic power system.

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rejection is accomplished with a radiator that emits thermal radiation to space.

Closed Brayton Cycle (CBC) engines are related to open cycle gas turbines found on aircraft as engines or auxiliary power units. CBC engines are capable of high thermodynamic cycle efficiencies—approaching 40 percent—which makes them ideal for use in electrical power generation systems for space. The NASA Lewis Research Center, in conjunction with industry, has been developing this technology for the past 30 years.

Options for Commercialization

One of NASA Lewis' objectives is to commercialize this technology and make it an alternative to conventional photovoltaic/battery power systems. Among the applications where SD technology can be used are commercial and DoD satellites in low-to-medium Earth orbits. To encourage commercialization, the Lewis Power Systems Project Office is actively pursing interested partners/customers to participate in the development of advanced SD designs.

Contact

Steven Johnson
Power Systems Project Office
Mail Stop 500-203
NASA Lewis Research Center
21000 Brookpark Road
Cleveland, OH 44135
Phone: (216) 433-5370
Fax: (216) 433-2995
E-mail: steven.johnson@lerc.nasa.gov

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